

CLAIMS

We claim:

- 5 *Sub A1*
1. A multi-module pipe repair inspection device, comprising:
a base module; and
a camera module connected to the base module.
 2. The device of claim 1, further comprising a locomotor module connected to the base module.
 3. The device of claim 1, further comprising a flexible joint connected between the base module and the camera module.
 - 10 4. The device of claim 1, further comprising a centralizer connected to the camera module.
 5. The device of claim 2, wherein the locomotor has a stepper motor.
-
- 15 *Sub A2*
6. A multi-module pipe marking device, comprising:
a base module;
a marker module connected to the base module; and
an MFL module connected to a marker module.
 7. The device of claim 6, further comprising a locomotor module connected to the base module.
 8. The device of claim 6, further comprising a flexible joint connected between the
20 base module and the marker module.
 9. The device of claim 6, further comprising a flexible joint connected between the MFL module and the marker module.
 10. The device of claim 6, further comprising a centralizer connected to the marker module.
 - 25 11. The device of claim 6, wherein the marker module includes:
a gas source;

a regulator connected to the gas source;

a marker valve connected to the gas source;

a purge valve connected to the gas source;

a marker reservoir tank connected to the marker valve;

5 a check valve connected to the purge valve; and

a nozzle head connected to the check valve.

12. A multi-module pipe preparation device, comprising:

a base module;

a sensor module connected to the base module; and

10 a brush module connected to the sensor module.

13. The device of claim 12, further comprising a flexible joint connected between the base module and the sensor module.

14. The device of claim 12, further comprising a flexible joint connected between the sensor module and the brush module.

15 15. The device of claim 12, further comprising a locomotor module connected to the base module.

16. The device of claim 12, further comprising a centralizer connected to the sensor module.

17. The device of claim 12, wherein the brush module includes a camera.

20 18. The device of claim 12, wherein the brush module includes a brush assembly, the brush assembly including at least one star-shaped brush wheel.

19. The device of claim 18, wherein the brush wheel is constructed of hardened steel.

25 20. The device of claim 18 wherein the brush assembly further includes a spring, wherein the spring keeps the brush wheel from contacting a wall of a pipe, and wherein

rotation of the brush assembly causes tension on the spring to be overcome and the brush wheel contacts the wall of the pipe.

5 ~~Sub 21. A multi-module pipe repair device, comprising:
a base module; and
a patch set/test module.~~

22. The device of claim 21, further comprising a flexible joint connected between the base module and the patch set/test module.

23. The device of claim 21, wherein the patch set/test module includes a bladder module and a supply module connected to the bladder module.

10 23. The device of claim 23, further comprising a flexible joint connected between the bladder module and the supply module.

24. The device of claim 23, wherein the supply module includes at least one tank and a regulator for regulating gas entry and exit from the tank.

15 25. The device of claim 23, wherein the bladder module includes an inflatable bellows for setting a patch to a wall of a pipe.

~~Sub 26. The device of claim 21, further comprising a locomotor module connected to the base module.~~

20 27. A multi-module pipe inspection and repair device, comprising:
a base module;
a camera module;
a sensor module;
an MFL module;
a brush module;
a patch set/test module;
25 a marker module; and

Sub 26 wherein each of the modules may be interconnected to construct one of an inspection device, a preparation device, a marking device, and a repair device.

28. The device of claim 27, further comprising a locomotor module.

5 29. The device of claim 27, further comprising at least one flexible connector for connecting at least two of the modules.

30. The device of claim 27, further comprising at least one centralizer connected to at least one of the modules.

31. A method of repairing a pipe, comprising:

attaching a patch to a multi-module pipe inspection and repair device;

10 inserting the device into the pipe;

locating a flaw in the pipe using the device;

preparing the flaw for repair using the device;

patching the flaw with the patch using the device; and

removing the device from the pipe.

15 32. A method of repairing a pipe, comprising:

inserting a marking device into the pipe;

marking at least one flaw in the pipe using the marking device;

removing the marking device from the pipe;

inserting a preparation device into the pipe;

20 preparing the flaw for repair using the preparation device;

removing the preparation device from the pipe;

inserting a patch module having a patch into the pipe;

repairing the flaw using the patch module; and

removing the patch module from the pipe.

25 33. The method of claim 32, further comprising preparing the pipe.

34. The method of claim 33, wherein preparing the pipe includes attaching an access system to the pipe and removing a portion of the pipe proximate the access system.

35. The method of claim 32, further comprising:

inserting an inspection device into the pipe;

inspecting the pipe using the inspection device; and

removing the inspection device.

36. The method of claim 32, wherein inserting a marking device into the pipe includes inserting a marking device having a base module, a marker module connected to the base module, and an MFL module connected to the marker module.

37. The method of claim 32, wherein inserting a preparation device into the pipe includes inserting a preparation device having a base module, a sensor module connected to the base module, and a brush module connected to the sensor module.

38. The method of claim 32, wherein inserting a patch module having a patch into the pipe includes inserting a patch module having a base module, a supply module connected to the base module, and a bladder module connected to the supply module.

39. The method of claim 35, wherein inserting an inspection device into the pipe includes inserting an inspection device having a base module and a camera module connected to the base module.

40. The method of claim 32, wherein preparing the flaw for repair using the preparation device includes abrading a wall of the pipe where the flaw is located.

41. The method of claim 32, wherein marking at least one flaw in the pipe using the marking device includes marking at least one flaw in the pipe with paint.

42. The method of claim 32, wherein repairing the flaw using the patch module includes affixing a flexible patch to a wall of the pipe.

43. A pipe inspection and repair system, comprising:
a coiled tubing unit having coiled tubing piping;

Sub
a6

a user interface in communication with the coiled tubing unit;
a pipe access system connected to a pipe;
a multi-module pipe inspection and repair device connected to the coiled tubing piping and adapted to enter the pipe through the pipe access system.

5 44. The system of claim 43, further comprising an interface connector connected between the coiled tubing unit and the device.

45. The system of claim 43, wherein the device includes:

a base module;

a camera module;

10 a sensor module;

an MFL module;

a brush module;

a patch set/test module;

a marker module; and

15 wherein each of the modules may be interconnected to construct one of an inspection device, a preparation device, a marking device, and a repair device.

46. The system of claim 45, wherein the device further includes a locomotor module.

47. The system of claim 43, wherein the user interface includes:

20 a controller board;

a user interface board in communication with the controller board;

a control panel in communication with the user interface board; and

a monitor in communication with the controller board.

48. The system of claim 43, wherein the pipe access system includes:

25 a sleeve attached to the pipe, the sleeve having a protruding portion;

a valve assembly connected to the protruding portion; and

Sub
a6

an access tube connected to the valve assembly.

49. The system of claim 48, wherein the protruding portion is oriented at approximately a 20 degree angle relative to the pipe.

50. The system of claim 48, wherein the valve assembly includes one of a ball valve
5 and a gate valve.

51. The system of claim 43, wherein the coiled tubing unit includes:

a tether spool;

a slip ring in communication with the spool and the user interface; and

a tether odometer in communication with the user interface.

10 52. A joint for connecting at least two modules of a multi-module pipe inspection and repair device, comprising:

an end shell;

a locking sleeve;

a spring connected between the end shell and the locking sleeve; and

15 a mesh connected between the end shell and the locking sleeve; wherein the mesh substantially surrounds the spring.

53. The joint of claim 52, wherein the locking sleeve includes at least one connector.

54. The joint of claim 52, wherein the spring creates a void, and further comprising a bundle connected to the locking sleeve, wherein the bundle is adapted to pass at least one of
20 a fluid, a gas, and an electrical signal.

Add
A7

Add
C5